Curation and characteristics of the Hayabusa-returned particles

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Asteroids are one of the main sources of interplanetary dust, although their contributions on it are still under discussion [1]. JAXA sent the spacecraft Hayabusa to the S-type Near-Earth Asteroid (NEA) 25143 Itokawa. It reached the asteroid in Sep. 2005, and performed twice touchdowns onto it in Nov. 2005 in order to obtain samples on its surface [2, 3]. It returned to the Earth in Jun. 2010, sending back its reentry capsule to the desert in Australia [4].

All the processes for sample recovery are detailed in [5]. After we received the reentry capsule to the Extraterrestrial Sample Curation Center (ESCuC), a sample container, which was situated inside the reentry capsule, was extracted from the capsule, cleaned its outer surface, and introduced into a specific vacuum chamber called as “clean chamber No.1.” It was disclosed in static vacuum condition and extracted a sample catcher inside the container in purified nitrogen condition of the chamber No.1. The catcher was sent to a clean chamber No.2, which is designed to handle small samples with an electrostatically controlled micromanipulator in purified nitrogen gas condition. The sample catcher is separated into three areas, room A, room B and a rotational cylinder. Then particles inside the catcher have been recovered and described with a field-emission type scanning electron microscope with an energy dispersive X-ray spectroscopy (FE-SEM/EDS) without conductive coating and exposure to terrestrial atmosphere.

The Hayabusa-returned samples have been recovered from the catcher in the three different methods in the following. At first, we scraped inside the catcher room A with a small Teflon spatula to recover particles on the spatula and observe them with the FE-SEM/EDS. More than 1000 of silicate particles on the spatula were described and firstly considered as Itokawa origin because its modal abundance of minerals was comparable to that of equilibrated LL chondrite [6]. Secondary, we prepared synthetic quartz glass disks to be set to the openings of both room A and B and tapped it to let particles inside fall onto them. Then we picked up particles on the disks one by one with the micromanipulator to analyze them with the FE-SEM/EDS. We also picked up particles from a cover of room B, which was recovered when we opened the room B. Third, we developed a special sample holder for FE-SEM to introduce the cover of room A into the FE-SEM and described particles on it directly with the FE-SEM/EDS in order to save time picking up particles.

So far, more than 400 particles, which size from 8 to 310 μm in major axes, have been described with the FE-SEM/EDS. 80% of them are silicate particles, which are estimated to be Itokawa origin. The rest of them are those consist mainly of carbon, whose origins are unknown, and artificial ones. More than 60% of the silicate particles are composed mainly of olivine, and more than 20% of them are dominated by pyroxene, and less than 10% of them consist mainly of plagioclase. Those dominated by iron sulfide or iron-nickel metal is around 1%, respectively.

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